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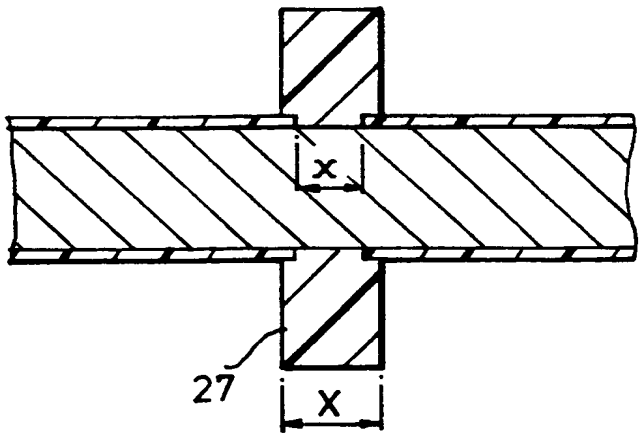

(57) Abstract

A thermoplastics collar (27) (Figure 4) is moulded onto a stabiliser bar (20) at at least one moulding position to give increased axial strength by firstly cleaning the bar by shot peening, masking the bar at each moulding position with a loop of meltable adhesive tape (22) (Figure 2), spraying powder paint onto the bar and then heating it both to fuse the paint into an integral layer (25) and melt and remove the masking, and finally moulding the component (27) onto the bar at each exposed moulding position. Preferably the moulded component is axially longer than the exposed moulding position and its ends are moulded onto the painted surface.

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Method of moulding a non-metallic component onto a metal bar

This invention relates to a method of manufacturing a bushed bar by the moulding onto a prepared bar at one or more predefined moulding positions integral non-metallic collar or bush components.

The term 'bar' is used in this specification for convenience of expression and unless specified as otherwise may, in its most general sense, mean not only an elongate solid object of round cross-section but also any non solid object, such as a tube or pipe, of any cross-sectional shape. Bars having such integrally moulded non-metallic components are often employed in situations where the bar is mounted on, and required to undertake restricted movements relative to, a body and the moulded non-metallic components may be required to permit the bar to undergo unlimited or restricted movement in one direction relative

to the body whilst restraining it from motion in another direction, often against considerable force. Such a non-metallic component may form a mounting bush for the bar and/or simply provide a collar for limiting axial motion relative to the body. Such restraint is due entirely to the strength of moulding bond between the non-metallic part and the bar but other manufacturing operations which require to be performed for technical and/or commercial reasons may conflict with and point towards compromising of an optimum bond.

Although the uses of bushed bars are manifold and any may benefit from the method to be described herein this method is particularly applicable to, and will be described in relation to, a stabiliser bar of the type used in motor vehicles to counter body roll.

Such a stabiliser, or anti-roll, bar is formed from steel rod having suitable torsion characteristics and mounted to the chassis of the vehicle by non-metallic components such as bushes of rubber or plastics material which are moulded integrally onto the bar at at least one, and usually a plurality of, predefined moulding positions along the bar.

Such bushes serve to permit rotational motion of the bar about its longitudinal axis relative to the chassis,

differential rotation along its length deriving torsional reaction forces to counter chassis roll.

Such a stabiliser bar having at least one non-metallic component integrally moulded thereto is described in British Patent specification No. 2,239,440. In both the present and this aforementioned specifications, the term integrally is used in relation to the moulding to mean that the component is formed to its final shape and bonded to the bar simultaneously from the melt by a moulding tool through which the bar passes, and is distinguished from a situation in which a pre-moulded component is simply secured to the bar.

It is evident that a stabiliser bar formed of steel to be employed in an exposed location under a vehicle requires to be given a protective surface coating of, for example, paint, but methods that comply with economical manufacture do not provided the bonding strength against lateral forces outlined above.

In one such production method it is required to produce finished bars at a rate which limits individual operations to less than 20 seconds each. For production reasons it has been found most effective for the surface of the bar to be given a protective surface coat of paint using a technique that involves exposing the bar to temperatures

above those that would deleteriously affect any thermoplastic material moulded onto the bar previously and to this end it has been seen as desirable for the non-metallic bush or collar component to be moulded onto the painted bar, despite adhesion being less than to an unpainted surface, provided the axial length of the component compensates by giving a large enough contact surface area.

However, such a viable production method produces problems if it is required to produce such a stabiliser bar having one or more non-metallic collars whose sole purpose is to limit axial displacement of the bar, and where it is inappropriate that each collar is of substantial axial length, as would befit a bush of the type illustrated in the aforementioned patent specification. To put this in perspective, it may be necessary to provide on a bar of some 2cm diameter a collar of integrally moulded thermoplastics material that has an axial length of 5-8mm. However, the collar may be called upon to withstand a lateral (axial) force between 2.5 KN or 3 KN, which forces have been just achievable in the longer bushes when the manufacture is such a commercial production environment.

Whereas the method of applying paint, or any other surface protection, may be varied if desired, possibly to one not requiring per se extremes of temperature, it is seen as

desirable to provide uniformity by confining the moulding of a collar of shorter axial length than such a mounting bush also to after the surface protection has been applied to the bar, but differing by the provision at an appropriate location, conveniently termed a moulding position, of a bar surface from which the paint or other surface protection material is absent so that superior bonding of the moulded component is effected.

This in itself raises some problems in a high volume production environment when locating the moulding tool accurately in relation to such unprotected moulding position in order to avoid ending up with a bar where there is any exposed unpainted surface, however small.

Similarly, it is unacceptable that a finished bar has any surface damage caused by operations thereon that could potentially be a source of weakness, so that methods of exposing moulding positions on a painted bar are limited.

Finally, it must be remembered that each distinct operation involved in preparing the exposed moulding positions must be compatible with the 20 seconds (or thereabouts) per operation schedule of manufacture.

Notwithstanding the specific nature of the above, nor neglecting the generality of a bar to which non-metallic

components of any material or dimensions are integrally moulded, it is an object of the present invention to provide a bar, and a method of manufacturing a bar, onto which both non-metallic components are moulded and a surface protection coat applied, that provides greater resistance to component bonding failure more cost effectively than hitherto.

According to a first aspect of the present invention a method of manufacturing a metal bar having at least one non-metallic component integrally moulded onto the bar at an individual moulding position along the bar, comprises cleaning the surface of the bar, masking the surface of the cleaned bar, at each moulding position, about its periphery for an axial distance along the bar with a meltable material, depositing surface protection material on the masked bar, subjecting the bar to a temperature above the melting point of the mask material to expose the unprotected bar surface at each moulding position, and moulding on the bar at each moulding position a non-metallic component.

In this specification the terms "melting" and "melting point" are employed in relation to the masking material to identify the loss of structural form assumed at ambient temperature and assumption of a state in which the material is unable to remain on the bar.

According to a second aspect of the present invention a bar has a surface coating of protective material bonded thereto except for an axially extending uncoated portion of the bar at at least one moulding position along the bar and at each moulding position a non-metallic component, moulded integrally onto the bar, having a centre portion thereof moulded onto the uncoated bar portion and the end portions thereof moulded onto the coated bar portions each side of the uncoated moulding position.

An embodiment of the invention as applied to vehicle stabiliser bars will now be described by way of example with reference to the accompanying drawings, in which:-

Figure 1 is a sectional elevation through a portion of a vehicle stabiliser bar showing a collar of thermoplastics material integrally moulded onto a painted bar using known production methods,

Figure 2(a) is a perspective view of a stabiliser bar, according to the present invention, at an early stage of manufacture wherein the cleaned shot peened bar has, at one or more moulding positions, the surface masked by the application of a loop of meltable plastics adhesive tape,

Figure 2(b) is a perspective view of the stabiliser bar of Figure 2(a) showing the bar masked at each moulding position,

Figure 3 is a sectional elevation through the bar of Figure 2(b) after painting and being subjected to high temperature to melt off the tape mask(s), and

Figure 4 is a sectional elevation through a portion of a finished bar according to the present invention and showing the bar of Figure 3 after having a collar of thermoplastics material integrally moulded thereon at the unpainted moulding position.

As mentioned above, the British patent specification No. GB 2,239,440 describes a vehicle stabiliser or anti-roll bar having one or more non-metallic components integrally moulded thereon and includes examples of a bar structure and methods of manufacture. Referring now to Figure 1 this shows a sectional elevation through a portion of such a bar 10 on which is moulded an axially short collar 11 to prevent axial displacement of the bar when mounted on a vehicle. It will be seen that in accordance therewith, the surface 12 of the bar has been shot peened both to condition the surface for torsion stresses to which it will be subjected in use and to provide a rough surface key for the surface protection paint.

The paint is applied by spraying electrostatically charged powder onto the bar and passing the coated bar through an oven which raises the bar to a temperature of above 180°C

(air temperature about 300°C) to fuse the paint into a uniform coat 13. Subsequently the collar 11 is moulded onto the painted surface. As indicated above the bonding provided by the plastics material to the paint, coupled with the small bonded area due to the short axial length of the collar, is insufficient for some needs.

In accordance with the present invention the method of manufacture differs as will be seen with reference to Figures 2 to 4.

Referring to Figure 2(a), a bar 20 is formed to the desired shape and stress relieved, if necessary, and then shot peened to clean and prepare the surface to the extent necessary and desirable for having a thermoplastics component integrally moulded thereonto and a protection surface coat of paint.

At each of one (or possibly more) predefined moulding positions 21(, 21'...) at which a collar is to be moulded on the bar, the bar surface is masked by applying a loop of meltable, adhesive tape 22.

It has been found that a thin self-adhesive tape of polyvinyl chloride (PVC) film coated with a thermoplastic pressure sensitive adhesive is suitable and many such tapes are commercially available primarily intended for other

applications. A preferred material is a PVC based tape having a low tack adhesive intended for protecting embossed or coarsely ground surfaces against abrasion and available from W K West Limited of Sheffield, United Kingdom, as Vinyl Protection Tape (1540). Such tape has a total thickness of 0.04mm. An alternative suitable material is a 0.035mm base thickness, 0.057mm total thickness, PVC based tape intended primarily for electrical insulation purposes and available from the above named source as Sellotape (RTM) Vinyl Electrical Tapes 1513/14.

Conveniently the tape is applied to all moulding positions simultaneously by means of a multiple-head tape dispenser 23 which operates by a reciprocal motion of the bar relative to the dispenser.

The masked bar 20, with its loop or loops of tape 22 (22')is illustrated in Figure 2(b).

The axial length of the tape mask at each moulding position is chosen to be slightly less than the axial length of the collar to be moulded at that position by an amount, determined in accordance with the positioning accuracy of the bar for both masking and moulding operations, that is sufficient to ensure that none of the bar surface covered by the mask 22 is subsequently not covered by the moulded collar 11.

The masked bar 20 of Figure 2(b) is thereafter coated with paint powder and subjected to an elevated temperature high enough not only to fuse the paint into a durable coating but also to melt each of the tape masks at least to the extent of causing the tape to shrivel and fall off, or even to flow or evaporate, such that when the painted bar emerges from the painting process it has with no further intervention an exposed, that is, unpainted, shot-peened surface at each moulding position. This is illustrated by the sectional elevation of Figure 3, which shows for bar 20 the roughened shot-peened surface 24 and paint layer 25 and the clearly delimited unprotected surface 26 at the moulding position.

Referring now to Figure 4, the final stage of the manufacture comprises integrally moulding a collar 27 onto the prepared bar at elevated temperature. The collar may be of any suitable material but, for ease of manufacture, conveniently comprises a thermoplastics material and for also providing strength against lateral forces may comprise a glass fibre reinforced, mineral filled polyphenylene sulphide composition, such as sold under the trade name FORTRON 6165A4 by Hoechst AG.

As indicated above, and as clearly illustrated in Figure 4, preferably the axial length X of the moulded component exceeds that x of the unpainted bar at the moulding position. The difference in length (X-x) need only be

sufficient to ensure that any positional tolerances in placing the bar relative to the masking station and later relative to the moulding station results in the painted portion always being covered by the moulded collar, and not exposed to corrosion. In practice such a length difference may be of the order to 1mm giving a positional tolerance for masking and moulding of +/- 0.5mm.

Although the above description relates to the production of a stabiliser bar with an axially short collar and painted in a manner which uses a paint fusing temperature that is also high enough to remove the mask material cleanly, it will be appreciated that the method may be employed to produce bars of any metal and of any type or cross-sectional or rectilinear shape for any purpose that requires the surface to be given a protective coating and have a non-metallic element moulded thereon. The non-metallic component may be axially longer than the collar described and any component of any length may extend to a greater or lesser degree onto protected (painted) bar portions adjacent the moulding position. In the ultimate, the moulded components need not extend to cover any part of the protected surface at all, depending on the use to which the bar is to be put, that is, the axial length of the component may be less than or equal to, the length of the exposed moulding position.

The method may be used with different protective coatings (paints or otherwise) that do not of themselves require subjecting the bar to high temperature, provided, of course, each is immune to a suitable elevated temperature used in order to melt and remove the masking. Similarly, it is convenient to choose a material such as polyvinyl chloride that melts below any elevated temperature already employed by the painting process, but if desired the temperature could be elevated in general, or locally, specifically to dispose of masking of a different material, whatever, and in dependence upon the thermal behaviour of, the meltable mask material.

The mask material desirably forms a complete loop around the periphery of the bar to maximise the unpainted area available for the moulding bond but it is believed acceptable if the loop is incomplete, that is, giving a line of paint across the moulding position, provided that sufficient unpainted area remains in relation to loads that have to be borne by the moulded component.

Furthermore the bar may be cleaned by methods other than, or in addition to shot peening, such as chemical degreasing.

It will be appreciated that by masking the bar and removing the masking automatically in this way avoids the

introduction of an additional manual or mechanical unmasking stage to detract from process efficiency and equally importantly ensures the masking is removed without risk of physical damage to the protected surface of the bar which, depending on the use to which put, may cause the bar to be rejected as a potential point of fracture.

CLAIMS

1. A method of manufacturing a metal bar (20) having at least one non-metallic component (27) integrally moulded onto the bar at an individual moulding position (21, 21', 26) along the bar comprising cleaning the surface (24) of the bar, depositing surface protection material (25) on the bar, and moulding on the bar at each moulding position a said non-metallic component, and characterised by masking the surface of the cleaned bar, at each moulding position, about its periphery for an axial distance along the bar with a meltable material (22, 22') prior to depositing said surface protection material on the bar, and subjecting the bar and deposited surface protection material to a temperature above the melting point of the mask material to expose the unprotected bar surface at each moulding position (26) prior to moulding on the bar said non-metallic component.

2. A method as claimed in claim 1 characterised by masking the surface (24) of the cleaned bar (20) at each moulding position (21) by a substantially complete loop (22) of self-adhesive tape of the meltable material, the width of the tape defining the axial length of the moulding position.

3. A method as claimed in claim 2 characterised by masking the surface with a tape having a base of polyvinyl chloride film.

4. A method as claimed in claim 3 characterised by masking the surface with a tape bearing a low tack thermoplastic pressure sensitive adhesive.

5. A method as claimed in any one of the preceding claims characterised by depositing the surface protection material as a fusible powder onto the masked bar and subjecting the bar to a temperature both to fuse the powder material into an integral coating and to remove, by melting, the masking material.

6. A method as claimed in any one of the preceding claims characterised by masking the surface of the cleaned bar at each of a plurality of moulding positions (21, 21') simultaneously.

7. A method as claimed in any one of the preceding claims characterised by moulding onto the bar (20) at each moulding position (26) a thermoplastics component (27) having an upper temperature tolerance less than the temperature to which the bar is subjected prior to the moulding.

8. A method as claimed in any one of the preceding claims characterised by moulding onto the bar (20) the non-metallic component (27) with an axial length (X) greater than the unprotected surface at the moulding position (x) such that the end portions of the component are moulded onto the surface

protection material (25) at each side of the unprotected surface (26).

8. A bar (20) having a surface coating (25) of protective material bonded thereto and, at at least one moulding position (21) along the bar, a non-metallic component (27) moulded integrally onto the bar, characterised in that each said moulding position comprises an axially extending uncoated portion (26) of the bar and each said component has a centre portion thereof moulded onto the uncoated bar portion and the end portions thereof moulded onto the coated bar portions each side of the uncoated moulding position.

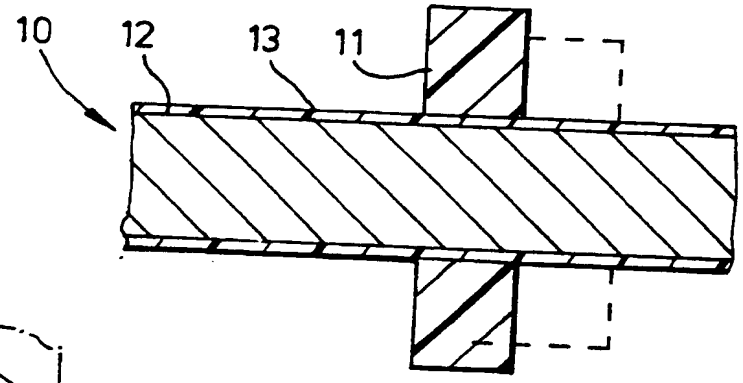

FIG. 1 (PRIOR ART)

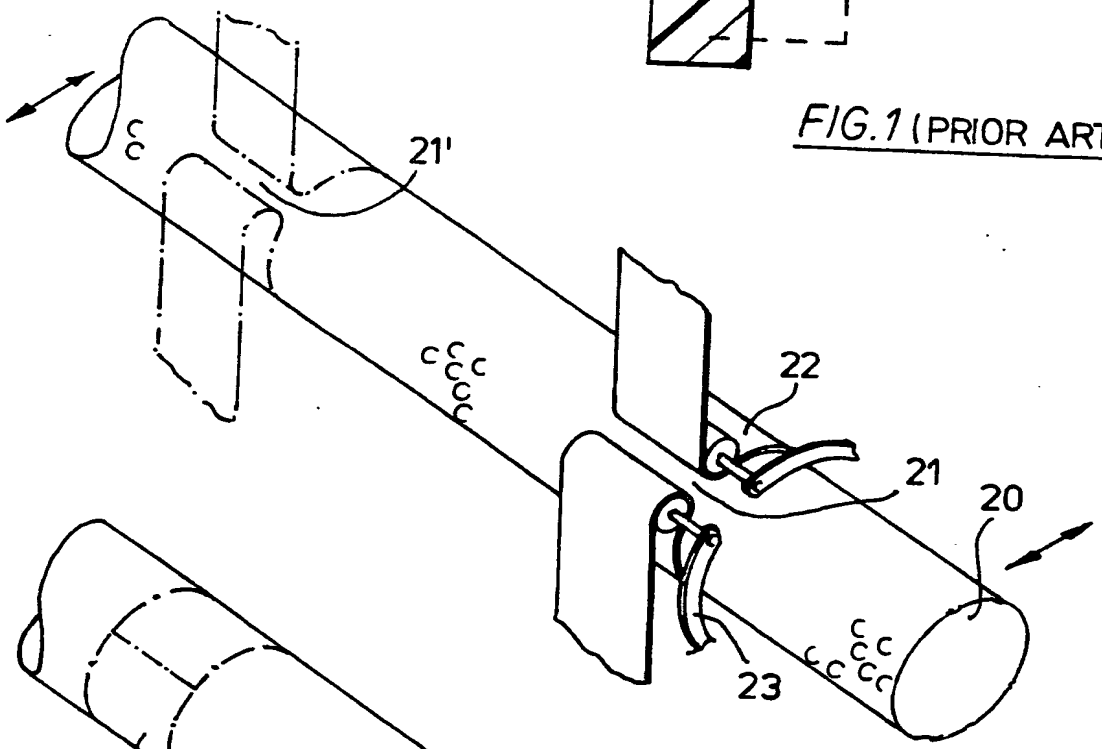

FIG. 2(a)

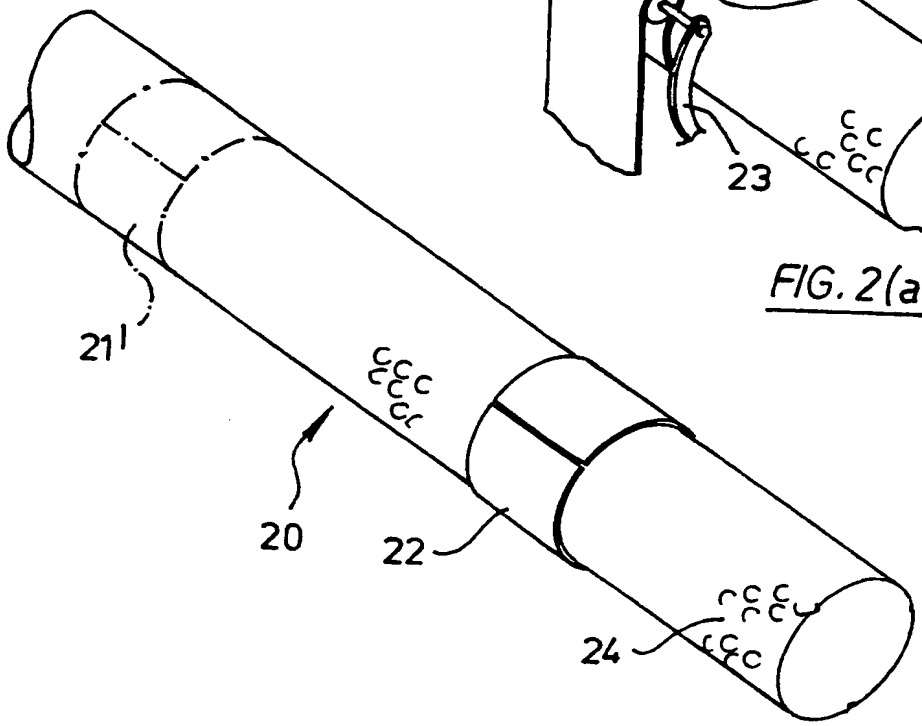

FIG. 2(b)

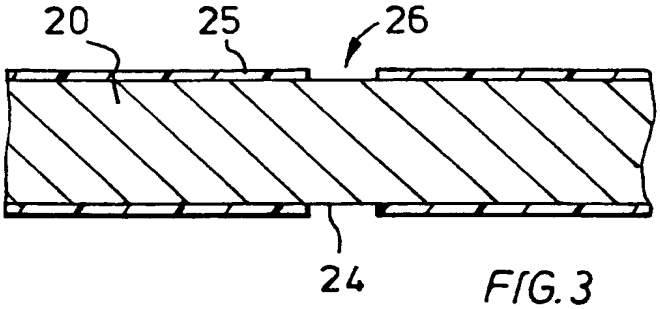

FIG.3

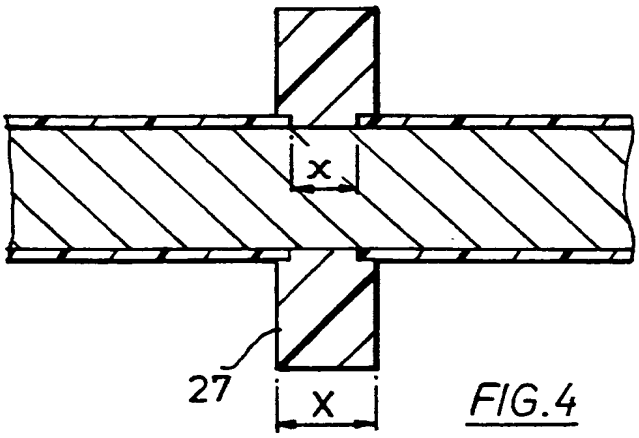

FIG.4

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 93/00041

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all)[6]

According to International Patent Classification (IPC) or to both National Classification and IPC

Int.Cl. 5 B05D1/32; B29C67/18; B60G21/055

II. FIELDS SEARCHED

Minimum Documentation Searched[7]

Classification System	Classification Symbols
Int.Cl. 5	B05D ; B29C

Documentation Searched other than Minimum Documentation to the Extent that such Documents are included in the Fields Searched[8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT[9]

Category °	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No.[13]
X	FR,A,2 641 494 (ALLEVARD INDUSTRIES S.A.) 13 July 1990 see the whole document	1,2,7-9
Y		3,5,6

Y	DE,B,2 526 185 (SIEMENS AG) 19 February 1976 see the whole document	3,5

Y	GB,A,2 239 440 (THE TEMPERED SPRING COMPANY LIMITED) 3 July 1991 cited in the application see claims 1,3	6

A	DE,A,2 034 180 (NAGOYA YIKAGAHU-KOGYO K.K.) 28 January 1971 see claims	1

° Special categories of cited documents : [10]

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
07 APRIL 1993	21. 04. 93
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	LANASPEZE J.P.Y.

Form PCT/ISA/210 (second sheet) (January 1985)

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO.

GB 9300041
SA 69017

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 07/04/93
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Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR-A-2641494	13-07-90	None		
DE-B-2526185	19-02-76	None		
GB-A-2239440	03-07-91	EP-A-	0460148	11-12-91
		WO-A-	9109748	11-07-91
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		US-A-	3667988	06-06-72